TITLE: "Reflectance of vegetation, soil, and water"

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Objective of the Contract:

The seasonal changes in reflectance of various soils and of various crops grown in Hidalgo County, Texas, are being studied using ERTS-1, ground, and low to medium altitude (3000-10,000 ft AGL) aircraft spectral data. Discrimination of specific crop and soil conditions is being attempted; chlorophyll content of plant leaves is being correlated with reflectance in the visible channels, and comparisons are being made between ERTS data and predictions from analytical models describing interaction of light with plant canopies.

Cloud-free ERTS Scenes:

The useable MSS CCT data furnished by NASA to date in support of the contract include:

Date	Orbit No.	Scene I.D.	MSS CCT Received	CCT Studied?
Dec. 16, '72	2035	1146-16323	Mar. 9, '73	Yes
Jan. 21, '73	2537	1182-16322	Mar. 14, '73	Yes
May 27, '73	4294	1308-16323	Sept. 14, '73	Partly
Sept. 12, '73	5800	1416-16310	Feb. 19, '74	No
Oct. 18, '73	6302	1452-16300	Ordered 1/21/74	No
Dec. 11, '73	7055	1506-16290	Ordered 2/4/74	No
		1506-16293		
Dec. 29, '73			Photoproducts not yet rec'd.	

Emphasis is being placed on analyzing the Jan. 21 and May 27, 1973, scenes. The January scene has a maximum of bare soil but also represents the winter vegetable season. The May 27 scene represents the warm season crops dominated by cotton and grain sorghum. The Dec. 16, 1972, scene is less desireable than the Jan. 1973 scene because of high thin cirrus and a few low cumulus clouds.

The September 12, 1973, scene is of interest because it was preceded by heavy rainfall that caused surface ponding. The scene offers the possibility of assessing flooding that existed at the time of the overpass. Both the September and Oct. 18, 1973, scenes would be difficult to interpret in terms of crops because of antecedent wet conditions that promoted growth of weeds and prevented the usual harvest of crops and the tillage of fields.

The December 11 and December 29, 1973, scenes are again back to our winter vegetable season. A hard freeze occurred on the night of December 20. Therefore, it is of interest to study the change in spectra of certain crops, such as sugarcane that was severely damaged by the freeze.

It is unlikely that all these various conditions and events can be studied under the contract, but the CCT are being requested in case the opportunities present themselves.

The tabulation of number of sample segments and individual fields that have been located from the county-wide sample in each of the data sets received to date, along with causes of nonidentification are:

Data processing status	Satellite data sets					
	12-16-73		1-21-73		5-27-73	
	Fields	Segments	Fields	Segments	Fields	Segments
Total located	1262	159	1292	193	778	103
Total missing	181	38	149	4	556	72
-Under clouds	75	9	-	-	-	-
-Not on CCT	3	3	-	-	-	-
-Split between CCT	4	2	-	-	-	-
-Cannot locate on gray maps	99	24	149	4	-	-
-Processing not complete	-	-	-	-	556	72
Total	1443	197	1441	197	1334	175
% of total located in CCT	87.4	80.7	89.6	98.0	Not yet completed	

For example, in the Dec. 16, 1972, scene a total of 9 sample segments comprising 75 individual fields were obscured by clouds or cloud shadows. Difficulty in locating segments is experienced in those parts of the county where soil patterns are complex; mosaics of high altitude aircraft photographs often have a mottled appearance in such areas. Segment and field boundaries are obscured by the variability in soil patterns in such cases. Field and segment boundaries are also undefined when adjacent segments and fields are spectrally noncontrasting.

For the Jan. 21, 1973, scene 193 out of 197 segments (1292 out of 1441 fields) have been identified and the spectra extracted from the CCT. Four segments were unlocatable because the segment boundaries could not be distinguished from the surroundings.

The difference in number of segments between January and May is explained by the elimination of ground truth collection of winter vegetable segments during summer months. The final count for May should be better than for January because better photographic aids were available to help locate segments and because CCT were merged into one tape, eliminating segments split between CCT. The photography from the SKYLAB pass of May 29, 1973, was used to help locate segments; it gave a truer indication of current ground conditions (ground cover, field divisions, urban development, etc) than the March 4, 1971, high altitude aircraft photography used in conjunction with the December and January data sets. The SKYLAB photographs corresponded closely with ERTS-1 band 5 images and computer gray maps using band 5.

Training Field Selection:

One of the problems of automatic land use mapping of agricultural scenes is the difficulty in matching ground truth to spectrally distinctive and meaningful agricultural discrimination categories.

The supervised training field selection technique used at Weslaco to date employs two-dimensional (2D) scatter diagrams of the MSS digital counts along with ground truth. The mean MSS ERTS-1 digital values for 1400 randomly located fields in Hidalgo County, Texas, are displayed in a 2D scatter diagram in which bands 5 and 7 are the two axes of the diagram. An alphanumeric label, corresponding to crop identification, geographical location in the County, crop ground cover, and crop condition, is used to indicate the identity of each field (as a 4 character point in the scatter diagram). Spectrally similar points form clusters in the diagrams. Since the fields of the scatter diagrams are representative of the County, training fields from the clusters are representative of crop and soil conditions in the County.

Currently, an unsupervised training field selection technique (clustering) is being adapted to determine the distinguishable spectral signatures present and where they are located geographically. (Such techniques have been successfully employed elsewhere, e.g. Ellefsen, R., Swain, R., and Wray, J. 1973, "Urban Land-Use Mapping by Machine Processing of ERTS-1 Multispectral Data: A San Francisco Bay Example," Proc. Conf. Machine Processing of Remotely Sensed Data, Purdue Univ., p. 2A-7.) Samples of the natural spectra, identified in the unsupervised mode, can be compared with known spectra displayed on 2D scatter diagrams to determine what known land use categories the natural spectra most closely resemble. It may be that some land use categories can be represented by more than one of the natural spectra discovered in the unsupervised mode. The computer program to be used at Weslaco for unsupervised training field selection is a modification of a one pass clustering program called CLUSTD developed by Haskell of the Earth Observations Division, Johnson Space Center, Houston.

Statement of Problems in the Report Period:

We are getting classification accuracies of about 60% for a typical set of agricultural land use categories, using either 10,000-foot altitude aircraft MSS or ERTS-1 MSS data. This low classification accuracy results, we believe, from the spectral similarity of various categories, and from the natural variability in the soil background. Thus we are looking into improving the selection of the training sample signatures, the stratification of the test county into areas that appear on ERTS-1 MSS imagery to be similar in soil background and land uses, and into the proportion of the MSS digital counts that can be explained by ground truth.

Utilization of Aircraft Data:

A paper has been accepted for presentation at the 9th Remote Sensing of the Environment Symposium at Ann Arbor in April in which MSS data simultaneously collected using the 24-channel aircraft MSS (Mission 226) and the ERTS-1 MSS are compared for crop recognition and acreage estimation using the two data sources; recognition maps and acreage estimates were very similar for one aircraft flight line (61.6 square kilometers of land area). In this case, the spacecraft MSS was as useful as the 10,000-foot altitude aircraft MSS data for discriminating agricultural land use categories.

Significant Results and Practical Applications:

To be cited in next Type II report.

Publications:

None.

Recommendations Concerning Changes in Operations, Additional Investigations, Efforts and Effort/Results as Related to the ERTS System:

See the section "Cloud-free ERTS Scenes" for worthwhile investigations suggested using ERTS data that are not covered by this contract.

Changes in Standard Order Forms:

None.

ERTS Image Descriptor Form:

None.

Changes in Retrospective Data Requests:

Will probably not order digital tapes of any scenes later than the December 29, 1973, scene.

Planned Work for the Next Reporting Period:

Statistical estimates of the acreages devoted to winter vegetables will continue to be produced as the winter vegetable season continues.

The spectra for the May 27, 1973, overpass (scene 1308-16323) will continue to be located in the CCT.

Improve training sample signature selection through the use of clustering, scene stratification, and other procedures and incorporate them into data processing procedures.

Produce county-wide estimates of acreages devoted to various major crops and land uses from January 21 and May 27, 1973, overpasses. Compare acreages with those determined from the ground truth statistical estimate of the County. Also, compare estimates obtained using a single training set for the whole County with composite estimates obtained using training signatures representative of southern, central, and northern subsections of the County.